REMARKS

The office action issued by the Examiner and the citations referred to in the office action have been carefully considered.

Objections under 35 U.S.C. §112

Claim 1 has been amended to address §112 issues raised in the most recent Office Action. The Office Action stated: "the phrase 'mixed with metal' is deemed vague and confusing as to what it is referring to." Claim 1 has been amended to clarify that it is directed to a method for preparing a hydrogen generation reactor chamber to reduce coking by cold spray of:

(a) alkaline oxide mixed with metal or

(b) oxides doped with alkali metal or alkaline earth compounds, mixed with metal.

Thus, the claim clarifies that either material selected (alkaline oxide or doped oxide) will be mixed with metal while applying the same during the cold spray. Other (dependent) claims have been amended to be made consistent with claim 1.

Claims 13-14 have been amended to clarify dependency and antecedent basis with regard to "mesochannels."

Claims 23-25 have been amended to be made more consistent with claim 1.

Rejections under 35 U.S.C. §103

Claims 1 and 23-25

Claims 1 and 23-25 were rejected under 35 U.S.C. 103(a) as being unpatentable over *Chang* (Applied Catalysis article) in view of DE 19900477 ("DE '477"). These four independent claims contain similar limitations, and shall be addressed simultaneously, using

claim 1 as a base reference. The following arguments are submitted as applied to all four independent claims.

The following references to and quotations of DE '477 are based on an English translation provided by the European Patent Office's esp@acenet.

Claim 1 recites: "applying a cold spray of an alkaline oxide or oxides doped with alkali or alkaline earth metals, mixed with metal to at least one surface within the chamber." The references cited, taken alone or in combination, fail to satisfy this claim limitation. Neither reference discloses a cold spray of alkaline oxide mixed with metal or oxides doped with alkali or alkaline earth metals, mixed with metal.

The Starting and Resulting Materials of Chang are not Amenable to a Cold Spray Process

The examiner correctly points out that *Chang* discloses a method for preparing coke resistant catalysts by the addition of alkaline promoters such as K and Ca oxides. In particular, *Chang* teaches a method to improve the coke resistance of Ni catalysts by producing zeolite supported Ni and KNiCa catalysts.

Chang obtains the disclosed KNiCa supported on zeolite by decomposition of nitrate salts. [*Chang*, p. 113, para 2]. Therefore, the starting material of *Chang* is not amenable to cold spray, since it does not contain any metal, as recited in the instant claims.

Furthermore, the resulting materials in *Chang* are also not amenable to cold spray. The nitrate mixture only manifests as the materials referenced by the Office Action as the nitrate mixture is "decomposed into metal oxides on the support at 650°C for 4 h." [*Chang*, p. 113, lines 9-10]. At this point, the materials have already been loaded onto the zeolite support, and are thereby not amenable to cold spray. To modify the teaching of *Chang* so as to disrupt the process by which the metal oxides are produced would render the process of *Chang* inoperable for its intended purpose.

The Method of Chang Teaches Away from a Cold Spray Process

The use of a metal suitable for a cold spray mixture is not taught by *Chang*. *Chang* discloses the use of potassium and calcium in the method of preparing its catalysts, stating: "While the homogenized nitrate mixture was slowly heated in air up to 450°C (2°C/min), it melted and gradually lost its water content." *Chang*, p. 113, lines 7-10. This is an important and necessary feature of *Chang*. Potassium and calcium are unstable in the presence of water, as is well known in the art:

> "[Potassium] is one of the most reactive and electropositive of metals. ... It rapidly oxidizes in air and must be preserved in a mineral oil such as kerosene. As with other metals of the alkali group, it decomposes in water with the evolution of hydrogen. It catches fire spontaneously on water." http://periodic.lanl.gov/elements/19.html.

Calcium is, similarly, unstable in the presence of water:

> "[Calcium] is highly reactive and unstable in moist air. In air, calcium forms a "hydration" coating. Calcium can be stored in dry air (30% or less relative humidity) - this is not recommended! Calcium reacts with water liberating hydrogen which may be auto-ignitable." http://www.hummelcroton.com/data/datap/ca_dp.html.

Thus, potassium and calcium would not be amenable to a cold spray process because a cold spray process would not include sufficient heat for the potassium and calcium to lose their water content, as required by *Chang*. During a cold spray process, the calcium and potassium would decompose, rendering the other features of Chang inoperable for its intended purpose. For these reasons, one having skill in the art would recognize that *Chang* teaches away from a cold spray process. As a result, a person of ordinary skill would not be motivated to use the materials of *Chang* in a cold spray process.

DE '477 Fails to Provide a Cold Spray of an Alkaline Oxide or Oxides Doped with Alkali or Alkaline Earth Metals, Mixed with Metal

As the Office Action concedes, *Chang* does not disclose a cold spray process. Thus, it would be incumbent upon DE '477 to disclose a cold spray of an alkaline oxide or oxides doped with alkali or alkaline earth metals, mixed with metal to at least one surface within the chamber.

The "cold gas spraying procedure" of DE '477 does not disclose the use of an alkaline oxide or oxides doped with alkali or alkaline earth metals, mixed with metal. DE '477 states: "For the coating by means of thermal squirting can become as spraying materials in particular metals, metal alloys, oxides (in particular metal oxides), carbides, Boride or mixtures of the aforementioned fabrics used." [translation of *DE '477*, col. 3, line 65-col. 4, line 1].

Merely mentioning metals and oxides in a laundry list of materials for a cold spray process does not provide a teaching that would enable—much less motivate—one having skill in the art to apply a mixture of (1) an alkaline oxide or oxides doped with alkali or alkaline earth metals and (2) metal to at least one surface within the chamber. For these reasons, it is respectfully submitted that the cited references do not teach or suggest the limitations of claim 1 and 23-25.

The Cited References Do Not Share an Analogous Field and are Directed to Separate Problems

The two references are directed to solving different problems with different processes and different materials.

The disclosure of *Chang* relates to activities of reforming methane for synthesis of hydrogen. *Chang* is concerned with providing coke resistance on catalysts during the reformation of methane, because coking would "deactivate the catalyst and plug the reactors." [*Chang*, p. 112, lines 18-19].

In contrast, the description of DE '477 states: "The invention relates to an apparatus to thermal cutting or welding, as well as a method for thermal cutting or welding." [DE '477, col.

1, lines 3-5]. DE '477 makes no mention of reformation processes, synthesis of gases, reaction catalysts, or resistance to coking or carbon deposition.

Rather, DE '477 is directed to solving problems introduced when constituents (i.e., a nozzle) of a laser welding device have lower heat resistance than the material upon which the device is operating. [DE '477, col. 2, lines 10-22]. Thermal and cold spray procedures are presented to reduce the susceptibility to damage occurring at high operating temperatures during welding, thereby extending the life of the device and lowering operating costs. [DE '477, col. 2, lines 27-35].

Because DE '477 is directed to heat resistance—rather than coking reduction—it calls for materials having "high melting temperature" and "high heat capacity"—rather than materials having resistance to carbon deposition. [DE '477, col. 3, lines 37-46]. Thus, a person having ordinary skill in the art would not be motivated to use the materials of *Chang* in the cold spray process of DE '477.

Because the cited references are directed to distinct solutions to distinct problems, a valid motivation to combine them cannot be established without impermissible hindsight analysis.

The Cited References Do Not Identify or Address the Problem Solved by the Present Application

The purpose of *Chang* is "to develop Ni-based catalysts which are resistant to carbon deposition, and exhibit high activity for the reaction." [*Chang*, p. 112, lines 15-17]. Thus, *Chang* is directed to improved catalyst materials because "[c]oke formation on Ni catalyst surfaces in the reforming reaction was known to deactivate the catalyst and plug the reactors." *Chang* repeatedly refers to the K and Ca oxides as "promoters," underscoring their function as catalyst promoters.

In contrast, the disclosure of the present application attempts to solve the problem of carbon formation on metal surfaces (reactor walls, connecting tubing)—that is, coking by homogeneous (non-catalytic) carbon formation. The invention is therefore not directed to the catalyst functionality disclosed by *Chang*.

As described in paragraph [0021] of the Specification, the catalyst is distinct from the cold sprayed metal surface (i.e., inner or outer surfaces of a tube). The function of the catalyst is to produce hydrogen while the function of the cold sprayed surface is to mitigate the formation of coke on the non-catalytic metal surfaces. [Specification, para. 0013].

Prior art solutions to this problem are identified in [0014]. The invention provides a novel and non-obvious solution to the problem of coking on the metal surfaces of the reaction chamber.

Chang teaches neither the problem identified by the present application nor the claimed solution to the problem. *Chang* teaches a method to improve the coke resistance of reforming catalysts that is not the subject matter of the claimed invention. *Chang* teaches the use of a quartz tube reactor. [*Chang*, p. 113, para 2, lines 19-21]. Quartz is well known in the art to be non-reactive (i.e., does not form coke, as opposed to metal surfaces). Therefore, *Chang* is not presented with the problem that the present application seeks to solve—reducing coking on non-catalytic metal surfaces.

DE '477 is not directed to reducing coking. DE '477 makes no mention of reformation processes, synthesis of gases, or resistance to coking or carbon deposition. Rather, DE '477 seeks to remedy low heat resistance of components of a laser welding device.

Because the cited references do not identify or address the problems solved by the claimed process, a valid motivation to modify either one cannot be established without impermissible hindsight analysis.

Claims 2-3, 21,

The Office Action rejected claims 2-3 and 21 under 35 U.S.C. § 103(a) as being unpatentable over *Chang* in view of DE '477. Dependent claims 2-3 and 21 depend from independent claim 1. As the independent claim from which they depend is patentable, as discussed herein, claims 2-3 and 21 rejected under 35 U.S.C. § 103 are patentable. Reconsideration is respectfully requested.

Claims 4-9, 11-18, 22

The Office Action rejected claims 4-9, 11-18, 22 under 35 U.S.C. § 103(a) as being unpatentable over *Chang* in view of DE '477 and further in view of Sanger et al. (6,190,623). Dependent claims 4-9, 11-18, 22 depend from independent claim 1. As the independent claim from which they depend is patentable, as discussed herein, claims 4-9, 11-18, 22 rejected under 35 U.S.C. § 103 are patentable. Reconsideration is respectfully requested.

It is respectfully submitted that all of the Examiner's objections have been successfully traversed and that the application is now in order for allowance. Accordingly, reconsideration of the application and allowance thereof is courteously solicited.

The Director is authorized to charge any additional fee(s) or any underpayment of fee(s), or to credit any overpayments to **Deposit Account Number 50-2298**. Please ensure that Attorney Docket Number 37929-31800 is referred to when charging any payments or credits for this case.

Respectfully submitted,

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